

## APPENDIX C

### TRANSPORTATION RELATED DATA

This appendix contains a variety of data that may be useful either in making computations or decisions related to daily or long-range planning. It includes odd pieces of information that are difficult to categorize or to find elsewhere.

#### CARGO DENSITY FACTORS

Most cargo cubes out before it weighs out. The following factors were developed to account for this condition.

##### Cargo Density by Supply Class

The data shown in Table C-1, page C-2, was obtained by analyzing military cargo records of medium truck companies. This information also applies when planning operations for other types of transportation units.

##### Weighted Mean Density by Supply Class

The data shown in Table C-2, page C-2, was obtained by analyzing actual shipment units. These data provide the weighting factors for computing weighted mean density. Weighted mean density of general noncontainerized cargo in common shipment unit configuration has been determined to be 16.08 pounds per cubic foot. Multiplying the density by the functional cube of a truck type determines the load the truck can carry.

#### MEAN CONTAINER CONTENT WEIGHT

Mean container content weight expresses truck unit container capability in tons as well as infinite

numbers of containers. The data shown in Table C-3, page C-2, was obtained by analyzing thousands of military cargo container prime records. Applying this data, the two types of medium truck companies that transport containers were determined to have the TOE capabilities discussed in the paragraphs below.

##### Medium Truck Company (Cargo, EAC), TOE 55727L100

This company is equipped with commercial design tractors and semitrailers. Each semitrailer carries one 40-foot container or two 20-foot containers at a time. TOE capabilities are as follows—

- Line-haul. Consists of 105 40-foot containers or 210 20-foot containers per day (total weight per truck not to exceed 34 STONs). In tonnage terms, this translates to line-hauling 1,620 STONs of containerized general cargo or 2,920 STONs of containerized ammunition per day.
- Local haul. Consists of 210 40-foot containers or 420 20-foot containers per day (total weight per truck not to exceed 34 STONs). This translates to 3,240 STONs of containerized general cargo per day or 5,840 STONs of containerized ammunition per day.

Table C-1. Cargo density by supply class  
(in pounds per cubic foot)

CLASS	DENSITY lb/cu ft	CLASS	DENSITY lb/cu ft
I	11.29	VI	12.19
II	10.28	VII	10.21
III	18.45	VIII	6.15
IV	13.11	IX	12.91
V	19.72		

Table C-2. Determining weighted mean density

CLASS	CONSUMPTION lb/man/day	PERCENT DISTRIBUTION
I	6.72	4.98
II	3.17	2.35
III	0.59	0.44
IV	4.00	2.96
V	79.96	59.22
VI	3.40	2.52
VII	34.17	25.31
VIII	1.10	0.81
IX	1.91	1.41
Totals	135.02	100.00
Weighted Mean Density		16.08

Medium Truck Company  
(Cargo, Corps), TOE 55728L100

This company is equipped with tactical design tractors and semitrailers. Each semitrailer carries one 20-foot container at a time. TOE capabilities are as follows—

- Line-haul. Consists of 102 20-foot containers per day (total weight per truck not to exceed

25 STONs). This translates to 658 STONs of containerized general cargo per day.

- Local haul. Consists of 203 20-foot containers per day (total weight per truck not to exceed 25 STONs). This translates to 1,315 STONs of containerized general cargo per day.

While ammunition is always transported in 20-foot containers, general cargo can be carried in either 20- or 40-foot containers. Also, general cargo containers frequently carry more than one supply class of cargo in a single container. Ammunition is never mixed with other commodities.

#### TASK VEHICLE AVAILABILITY RATE

The TVAR is defined as the average of the percentage of task vehicles available for mission accomplishment over time. Because TVARs are SRC-specific, they allow for a more accurate determination of truck unit capability based on the type of trucks in each unit. Elements that influence TVAR include:

- Task mission distance and duration.
- Vehicle reliability.
- Driver availability.
- Repair parts delay time.
- Mechanic availability.

The TVARs for each truck type/model are indicated in Table C-4, page C-3. These TVARs should be used when calculating resource requirements or truck capabilities.

Table C-3. Mean content weight in tons by container size

CONTENTS	CONTAINER SIZE	
	20-Foot	40-Foot
Ammunition	13.90	
General Cargo	6.47	15.42

## SUPPLY

Transportation requirements result from supply requirements supporting sustainment operations in combat. Mode selection of transportation assets are directly effected by the quantity of supplies required, distances to be marched, and time required to meet demands.

### Classes of Supply

The Army uses classes of supply to identify the different types of materials used for military operations. There are ten classes of supply. A general description of the type of material in each class is as follows:

- Class I – subsistence.
- Class II – clothing, individual equipment, tents, tools, and other supplies.
- Class III – petroleum, oil, lubricants, and fuel products.
- Class IV – construction/barrier material.
- Class V – ammunition.
- Class VI – personal demand (exchange) items.
- Class VII – major end items (tanks, vehicles, generators, radios, etc.).
- Class VIII – medical supplies.
- Class IX – repair parts.
- Class X – material for nonmilitary programs.

### Quantities

Based on a number of factors, the quantities of materials used by an Army force in combat operations will vary. These factors include:

- Climate and terrain in the area of operations.
- Intensity of combat.
- Size of the force.
- Distances to be traveled.
- Type and quantity of supplies available in the host country.

When the details of a combat operation are not known or rough resupply estimates are required, general pounds-per-man-per-day planning factors can be used for most classes of supply. To estimate

resupply requirements, the planning factors listed in Table C-5, page C-4, should be multiplied by the number of men deployed.

### Unit Weight for Shipment

For planning purposes, the weight in STONs of a unit is the sum of its combined weights. This total includes the following weights:

- TOE personnel and individual equipment, assuming an average weight of 240 pounds per man.
- Major items of organizational equipment.
- Class I supplies for three days, assuming 7.52 pounds per ration per man per day.
- Class III supplies necessary to move a unit 100 miles from the destination point after arrival, if authorized in shipment.
- Basic load of Class V.
- Added items that may be authorized by the theater or CONUS commander.

Table C-4. Task vehicle availability rates  
for the five truck types/models

TYPE	UNIT	SRC	TASK VEHICLE	TVAR (Percent)
MED TRK CO				
EAC Cargo		55727L100	M915	87.5
MED TRK CO				
Corps Cargo		55728L100	M931	84.7
LT MED TRK CO				
Corps		55719L200	M923	85.9
LT MED TRK CO				
Corps		55719L200	M923A1	91.2
MED TRK CO				
PLS Corps				
Cargo		55728L300	PLS	90.5

Table C-5. Planning factors for estimating resupply requirements

CLASS OF SUPPLY	PLANNING FACTOR				SOURCE
Class I – A-RATION	2.549 lb/man/day				SB 10-260, FM 10-13
B-RATION	1.278 lb/man/day				SB 10-495
T-RATION	2.575 lb/man/day				NATICK PAM 30-2
MRE	1.570 lb/man/day				NATICK PAM 30-2
LRP(I)	1.250 lb/man/day				NATICK PAM 30-2
R/CW	2.750 lb/man/day				NATICK PAM 30-2
HCP1	.770 lb/man/day				NATICK PAM 30-2
HCP2	.055 lb/man/day				NATICK PAM 30-2
EXAMPLE RATION POLICY:					
1A + 1T + HCP1 + HCP2	= 7.52 lb/man/day (D-DAY to D+60)				
1A + 1T + _____ + _____	= 6.69 lb/man/day (after D + 60, AAFES in Theater)				
Class II –	3.17 lb/man/day				FM 101-10-1/2 (1987) (See * below for CDE)
Class III (packaged) –	.51 lb/man/day				SB 710-2, Jan 91
Class IV –	8.50 lb/man/day				FM 101-10-1/2 Made up of 4.0 barrier material & 4.5 base construction
Class VI – (After D+60)	2.06 lb/man/day (temperate) 3.40 lb/man/day (trop/arid)** 1.75 lb/man/day (arctic)**				AAFES Exchange Service Regulation- 8-4 Change 1, Mar 93
Class VIII (lb/man/day) – Division	INT .65	MOD .46	LIGHT .28	RES .14	AMEDD Center and School (1992)
	Non-Division 1.46		.63	.31	
	Theater 1.55	1.10	.67	.33	
Water (gal/man/day)					FM 10-52 (1990)
	TEMPERATE		ARCTIC		TROPIC ARID
Company	3.9		4.4		5.7 5.9
Battalion	6.6		7.2		8.5 8.7
Brigade	7.0		7.6		8.9 11.1
Division	7.0		7.6		8.9 11.9
Above division	7.8		8.4		9.9 18.4
* Per IDA Study on CDE, 1986-1988, add the following chemical defense equipment modifiers for:					
NATO + 2.205 lb/man/day					
NEA + 3.270 lb/man/day					
SWA + 4.038 lb/man/day					
CDE notes:					
1. CDE consumption planning factors are for up to 30 days.					
2. CDE consumption planning factors assume troops change chemical protective suit and chemical protective boots every 30 days unless mandated earlier by METT-T.					
** Per AAFES Exchange Services Regulation 8-4, Emergency Operations, Appendix 8, Page AB-1, "For operations beyond D+180, add .03580 lb/man/day for supplemental stock assortments."					

### Planning Factor Data

The consumption factors listed in Table C-6 can be used for the type division shown and are considered valid for the MRC-East environment at the moderate level of combat. For the most current logistic planning factor data for all size units (battalion, brigade, division, or corps), contact:

Cdr, USACASCOM, Chief, Planning Factors Branch  
ATTN: ATCL-FSP, Mr. Fitzjarrald or Mr. Blair  
Fort Lee, VA 23801-6000  
DSN 539-0639, FAX 539-0661

Class I (explosives) materials shall not be loaded, transported, or stored together, except as provided in this section, and in accordance with Table C-7, page C-6. For detailed shipment data on ammunition, contact:

HQ, US Army Armament Munitions and Chemical Command (AMCCOM)  
Joint Munitions Transportation Coordinating Activity, AMSMC-TMJ-T  
DSN: 793-4707/5408/6597, CML: 309-782-4707/5408/6597.

Questions about specific packaging information on ammunition should be addressed to:

HQ, AMCCOM, SMCAR-ESK,  
DSN: 793-8204 or CML: 309-782-8204

NOTE: More than 14,000 packaging configurations are possible. Clearly, it is not practicable to provide even a partial list of those possibilities here.

### Planning Terms

Planners should be familiar with terms commonly used in logistic planning. Definitions for some of the most frequently used terms are as follows:

- Consumption rate. The average quantity of an item consumed or expended during a given time interval, expressed in quantities per applicable basis.
- Day of supply. Quantity of supplies estimated to be required for one day under the conditions of the operation and for the force stated.
- Replacement factor. A number expressed as a decimal which, when multiplied by the total projected quantity of an item in use, gives the quantity of the item that needs to be replaced during a given period.
- Slice. An average logistical planning factor used to obtain estimates of requirements for personnel and material.

### Storage

This section contains terms, definitions, and associated data useful to planners. When computing or selecting between long- or short-term storage, consider the following:

Gross storage area. See Table C-8, page C-7, for the average ratio of open-to-covered gross storage area by classes of supply.

Average stack height. The following figures are for average stack height. They can be used by all services in the theaters of operation.

- Covered storage – 8 feet (2.4 meters)
- Open storage – 6 feet (1.8 meters)

For CONUS storage, these figures must be increased by 25 percent.

Table C-6. Consumption factors

TYPE DIVISION	CLASS III	CLASS V	CLASS VII	CLASS IX
Armored (M1)	606,940 gal/day	1452 STONs/day	572 STONs/day	43 STONs/day
Infantry (Mech – M1/M2)	580,067 gal/day	1442 STONs/day	538 STONs/day	40 STONs/day
Light (LID)	69,488 gal/day	651 STONs/day	78 STONs/day	4 STONs/day
Airborne	102,783 gal/day	677 STONs/day	119 STONs/day	4 STONs/day
Air Assault	270,196 gal/day	847 STONs/day	198 STONs/day	6 STONs/day

Table C-7. Transportation compatibility table for Class I (explosives) material

COMPATIBILITY GROUP	A	B	C	D	E	F	G	H	J	K	L	N	S
A	X	X	X	X	X	X	X	X	X	X	X	X	X
B	X		X	4	X	X	X	X	X	X	X	X	4/5
C	X	X		2	2	X	X	X	X	X	X	3	4/5
D	X	4	2		2	X	X	X	X	X	X	3	4/5
E	X	X	2	2		X	X	X	X	X	X	3	4/5
F	X	X	X	X	X		X	X	X	X	X	X	4/5
G	X	X	X	X	X	X		X	X	X	X	X	4/5
H	X	X	X	X	X	X	X		X	X	X	X	4/5
J	X	X	X	X	X	X	X	X		X	X	X	4/5
K	X	X	X	X	X	X	X	X	X		X	X	4/5
L	X	X	X	X	X	X	X	X	X	X	1	X	X
N	X	X	3	3	3	X	X	X	X	X	X		4/5
S	X	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	4/5	X	4/5	

(A) Instructions for using this table are as follows:

- (1) A blank space in the table indicates that no restrictions apply.
- (2) The letter "X" in the table indicates that explosives of different compatibility groups may not be carried on the same transport vehicle.
- (3) The numbers in the table mean the following:
  - (a) "1" means an explosive from compatibility group L shall only be carried on the same transport vehicle with an identical explosive.
  - (b) "2" means any combination of explosives from compatibility groups C, D, or E is assigned to compatibility group E.
  - (c) "3" means any combination of explosives from compatibility groups C, D, or E with those incompatible group N is assigned to compatibility group D.
  - (d) "4" means §177.835 (g) when transporting detonators.
  - (e) "5" means Division 1.4S fireworks may not be loaded on the same transport vehicle with Division 1.1 or 1.2 (Class explosive) materials.

(B) Except as provided in paragraph (a) of this section, explosives of the same compatibility group but of different divisions may be transported together provided that the whole shipment is transported as though its entire contents were of the lower numerical division (i.e., Division 1.1 being lower than Division 1.2). For example, a mixed shipment of Division 1.2 (Class A explosive) materials and Division 1.4 (Class C explosive) materials, both of compatibility group D, must be transported as Division 1.2 (Class A explosive) materials.

(C) When Division 1.5 (blasting agent) materials, compatibility group D, are transported in the same freight container as Division 1.2 (Class A explosive) materials, compatibility group D, the shipment must be transported as Division 1.1 (Class A explosive) materials, compatibility group D.

Table C-8. Ratios of gross storage area by classes of supply

	RATIOS OF GROSS STORAGE AREA	
	Open	Covered
All classes (except bulk POL)	5.5	1
Classes I, II, III (packaged and solid), and IV	4.7	1
Class V (including 10% of V-A)	12	1

Ammunition. Ammunition storage per mile (1.6 km) of road is 1,000 short tons. Ammunition storage per square mile is 5,000 short tons. Table C-9 contains dimensions for packaged missiles and other special ammunition.

Vehicles. The minimum hardstand for 2,500 vehicles is 110,000 square feet. Solid footing for a vehicle park for 2,500 vehicles is 4,000,000 square feet. Minimum hardstand for artillery and combat vehicles per item is 350 square feet.

Containerized and bulk cargo. Table C-10, page C-8, gives the dimensions of drums, cans, and pails. Table C-11, page C-8, shows bulk cargo capacity.

Table C-9. Packaged missiles and other special ammunition

WEAPON	CONTAINER AND CONTENTS	CONTAINER DIMENSIONS			VOLUME (cu ft)	GROSS WEIGHT (lb)	REMARKS
		Length (in)	Width (in)	Height (in)			
Hawk	Complete round	216.00	28.75	41.50	150.7	3,351	Shipping & storage container, GM System XM547 (tripak)
Redeye	Three complete rounds	56.40	15.00	12.50	6.1	144	
Redeye	Unipack, one round	56.50	10.00	15.50	5.1	50	metal container
Shillelagh	Complete round	52.50	14.75	14.75	6.8	116	
Chaparral	Complete round	12.50	18.00	19.00	24.7	280	
Hellfire	Complete round	76.20	15.50	16.50	11.3	185	
Tow	Complete round	58.25	11.67	11.67	4.5	87	
Dragon	Complete round	47.50	16.00	16.00	7.0	67	
Stinger	Complete round	67.25	13.13	10.50	5.3	77	
ATACMS		166.00	41.50	33.00	131.5	4,814	one round per container
MLRS	Six-round pod	166.00	41.50	33.00	131.5	5,078	six-round shipping & firing configuration
Patriot	Complete round	234.00	42.38	38.75	231.4	3,750	typical stack has two rounds

Table C-10. Dimensions of containers

NOMENCLATURE	UNITS PER PACKAGE	TYPE OF PACKAGE	SIZE OF PACKAGE		
			Width or Length (in)	Diameter (in)	Height (in)
Drum					
US 55-gal, 16 gauge	1	drum	0	23 7/16	35
US 55-gal, 18 gauge	1	drum	0	23 7/16	35
Can					
US 5 gal (fuel)	1	can	13.75	6.75	18.5
US 5 gal (oil)	2	case	—	11 15/16	14 13/16
US 5 qt (oil)	6	case	—	14.0	10.0
US 1 qt (oil)	24	case	16.375	12 3/16	11.625
Pail					
US 35 lb	1	pail	0	11.5	13 9/16

NOTE: Source document is FM 10-69, Appendix A.

Table C-11. Bulk capacities

CARRIER	CAPACITY (gal)	JP-8 (STONs)
Pipeline <sup>1</sup> 6 inch	719,880 per day <sup>2</sup>	3,500
Railroad tank car	8,000; 10,000; 12,000	24.1; 30.6; 36.8
Semitrailer, 12 ton, 4W	5,000	15.3
Tank, portable fabric <sup>3</sup>	10,000	30.6

<sup>1</sup> In maintaining the same volumetric pipeline capacity for gasoline and oil, more pressure is required for the heavier liquid.

<sup>2</sup> Based on 6-inch IPDS (inland petroleum distribution system), 35,994 per hour for 20 hours of operation. In an emergency it can deliver 48,006 gallons per hour for 24 hours of operation or 1,152,144 gallons per day.

<sup>3</sup> When full, 40 feet long, 12 feet wide, 3 feet high. When empty, it can be rolled to 20 inches by 12 feet; 10 can be carried in a 6 x 6 truck.

Tentage. Table C-12, page C-10, lists the types of tents, their dimensions, and ground perimeter. Table C-13, page C-11, lists the types of tents and total weight. For updated tent information (weight and cubes of items in question), check the AMDF packaging section. If the data you need is not available, please contact the following:

Defense Personnel Support Center  
2800 South 20th Street  
Philadelphia, PA 19101-8419

(To receive assistance, you must have an NSN. Nomenclature alone is not sufficient).

#### NONTRADITIONAL TRANSPORTATION MODES

Army special operations are conducted throughout the world in all climatic and terrain conditions. Alternate methods of transportation must be used to meet mission requirements. They include use of the following.

##### Dogs

Trained dogs may be used individually or in teams to transport cargo in arctic areas. They also have

limited use in temperate zones to carry messages and small packages of mail, usually in regions inaccessible to other means of transport. Dogs should be permitted to rest 10 minutes in each hour and should not be worked continuously for more than 16 hours per day. For planning purposes, towed loads should not exceed 100 pounds per dog, although the heavier breeds are capable of loads of 200 pounds per dog on a flat surface with good traction.

The Eskimo dog, or husky, is most commonly used in arctic and subarctic regions – the German Shepherd in temperate zones. On packed snow with good traction, an individual dog in a sled team has the cargo-carrying capabilities shown in Table C-14, page C-12, for carrying cargo packs, messages, and mail. These figures are under normal operating conditions and vary widely under extremes of weather and terrain. Table C-15, page C-12, shows the carrying capacities of pack dogs over various terrain. On hard surfaces with good traction, an individual dog has the capabilities shown in Table C-15 for carrying cargo packs, messages, and mail.

#### Pack Mule

Pack mules are normally 59 to 62 inches tall and weigh 1,000 to 1,200 pounds. They travel at a rate of 3.5 to 4 miles (5.6 to 6.4 kilometers) per hour. Pack mules can carry from 200 to 250 pounds in equipment or supplies or transport two litter or two sitting casualties.

They can travel an average daily distance of 12 miles (19 kilometers) in mountainous terrain and 24 miles (39 kilometers) in rolling or flat terrain. Pack mules ascend at the rate of 1,650 vertical feet (503 meters) per hour. They are noneffective approximately 3.2 percent of the time.

Pack mules need 10 pounds of oats and 14 pounds of hay per day. These amounts may be reduced for short periods up to 10 days without impairing capability. Also, pack mules must have at least 10 gallons of water per day. For criteria for transporting pack mules, see Table C-16,

page C-12. Horse- or mule-drawn carts are capable of traveling 20 miles (32 kilometers) per day drawing a payload of 1,000 pounds.

#### Human Bearers

Males can carry an average cargo load of 80 pounds. Females can carry an average cargo load of 30 to 35 pounds. Each litter team consists of 8 to 12 humans.

For average conditions on level terrain, teams can march an average of 12 miles per day. To estimate the time needed to cover a given distance in hilly or mountainous areas, use the following equation. (For these conditions, cargo loads given above for males and females should be reduced from 20 to 30 percent, depending upon the steepness of the terrain.)

$$T = t + a + d$$

where:

$T$  = total time required

$t$  = time required to march a given map distance

$a$  =  $\frac{\text{total ascent in feet during march}}{1,000}$

$d$  =  $\frac{\text{total descent in feet during march}}{1,500}$

Tactics such as overloading or speeding up operations can increase the sick rate and cause desertion. Human bearers are noneffective about 30 percent of the time and must be closely supervised to prevent pilferage.

#### COLD WEATHER OPERATIONS

Soldiers must be able to conduct military operations for extended periods of time under the most severe and varying cold weather climatic conditions. Troops properly trained in the following will be able to perform in any cold weather area of the world. The weather conditions in extremely cold areas make operations for friendly and enemy forces difficult. These conditions can also directly effect equipment operations capability.

Table C-12. Tentage data (dimensions and ground perimeter)

TYPE	FLOOR DIMENSIONS (in)	GROUND PERIMETER (in)	SIZE		SURFACE AREA (sq ft)	FLOOR SPACE (sq ft)
			Ridge (in)	Side Wall (in)		
<b>Tents</b>						
Arctic, 10-man	210 dia	630	102	36	316	199
Assembly	480 x 960	2,467	252	96	4,965	2,857
Balloon, inflation	159 x 182	682	148	1	885	201
CP, M1942	84 x 142	452	84	72	328	84
CP, M1945	120 x 247 <sup>2</sup>	627	108	66	406	172 <sup>2</sup>
Fly, squad	240 x 251	1,382	144	63	1,673	750
Fly, ward, hosp	240 x 648	1,776	144	63	2,216	1,080
GP, large	216 x 624	1,680	144	66	2,035	936
GP, medium	192 x 396	1,176	120	66	915	528
Hexagonal, M1950	159 dia	477	102	24	218	113
Hospital, sectional	216 x 636 <sup>3</sup>	1,704	144	72	2,170	954 <sup>3</sup>
Hospital, ward	192 x 600	1,584	144	54	2,162	800
Kitchen	144 x 216	720	144 <sup>4</sup>	72	831	216
Maint, shelter	218 x 322	1,080	164	66	1,306	487
Mountain	54 x 82	272	43	12	112	31
Op, surgical	192 x 324	1,032	144	84	1,190	432
Op. surgical, hv	216 x 648	1,728	133	72	2,068	972
Pyramidal	192 x 192	768	144	63	896	256
Pyramidal, lightweight	132 dia	414	102	24	182	95
Squad, M1942	192 x 384	1,152	144	54	886	512
Squad, M1945	192 x 384	1,152	144	54	886	512
Storage	214 x 241	910	156	63	1,008	358
Wall, large	168 x 174	684	132	54	570	203
Wall, small	106 x 110	432	102	45	284	81
<b>Paulins<sup>5</sup></b>						
Fly, storage	300 x 245				512	
Fly, wall, small	186 x 110				142	
Large	240 x 480				800	
Medium	192 x 384				512	
Screen, latrine	216 x 108 x 84 <sup>6</sup>	660		72 <sup>7</sup>	292	144
Small	144 x 204				204	

<sup>1</sup> Arched top.<sup>2</sup> The two measurements shown are the longest dimensions, including vestibule (trapezoid measuring 120 x 48 x 89.5 x 89.5 inches).<sup>3</sup> Does not include vestibules at each end, which measure 48 x 90 inches.<sup>4</sup> Height shown is for stack section. Service section is 108 inches high.<sup>5</sup> Dimensions shown for flys and paulins are length and width.<sup>6</sup> Screen has a 3-foot overlap on one side for an entrance.<sup>7</sup> Bottom edge of screen normally 9 inches off ground.

Table C-13. Tentage data (weight)

TYPE	WEIGHT (LB)		TOTAL WEIGHT (lb)	BULK STORAGE		TOTAL CUBE PACKED (cu ft)
	Tent Only	Pins, Poles		Tent Only (cu ft)	Pins, Poles (cu ft)	
<b>Tents</b>						
Arctic, 10-man	68	8	76	7.1	0.2	7.3
Assembly	1,100	655	1,755	23.3	16.9	40.2
Balloon, inflation	110	333	443	6.3	3.6	9.9
CP, M1942	112	104	216	4.3	5.0	9.3
CP, M1945	165	92	257	7.6	4.5	12.1
Fly, squad	190	62	252	21.0	7.7	69.0 <sup>1</sup>
Fly, ward, hosp	225	101	326	12.7	6.3	19.0 <sup>2</sup>
GP, large	420	245	665 <sup>3</sup>	3.6	0.2	3.8
GP, medium	255	200	455 <sup>2</sup>			
Hexagonal, M1950	40	8	48	31.5	12.2	43.7
Hospital, sectional	770	327	1,097			
Hospital, ward	390	259	649	20.5	9.6	30.1
Kitchen	203	217	420	14.2	12.0	26.2
Maint, shelter	500	755	1,255			
Mountain	6	4	10	26.3	58.0	84.3
Op, surgical	252	75	327	0.5	0.2	0.7
Op, surgical, hv	817	876	1,693			
Pyramidal	130	94	224	10.3	3.5	13.8
Pyramidal, lightweight	37	2	39	38.8	23.2	62.0
Squad, M1942	255	147	402	2.5	0.2	2.7
Squad, M1945	275	150	425	10.9	5.9	16.8
Storage	200	202	402	11.1	6.1	17.2
Wall, large	130	145	275	9.6	9.2	18.8
Wall, small	55	60	115	5.8	3.1	8.9
<b>Paulins</b>						
Fly, storage	85	20	105	3.4	4.1	7.5
Fly, wall, small	23	15	38			
Large	250		250	2.8	0.8	3.6
Medium	160		160	3.1	0.7	3.8
Screen, latrine	32		32	6.7		6.7
Small	57		57	4.2		4.2

<sup>1</sup> Bed patients on cots.<sup>2</sup> Liner weighs additional 90 pounds and occupies a stored cubage of 8 cubic feet.<sup>3</sup> Liner weighs an additional 155 pounds.

Table C-14. Cargo-carrying capabilities of sled dogs

TERRAIN	LOAD PER DOG <sup>1</sup> OR (lb)	DISTANCE PER HOUR <sup>2</sup>	
		(KM)	(MI)
Flat	50	9.6	6
Hilly	50	4.8	3
Mountainous	50	1.6	1

<sup>1</sup> Includes weight of sled  
<sup>2</sup> Reduce 50 percent when load is doubled

Table C-15. Carrying capacities of pack dogs

TERRAIN	LOAD PER DOG		DISTANCE PER HOUR			
	Cargo Pack (lb)	Messages or Mail	Cargo Pack (km)	(mi)	Messages or Mail (km)	(mi)
Flat	35	5 percent of dog's weight	3.2	2	24	15
Hilly	30		3.2	2	16	10
Mountainous	25		1.6	1	8	5

Table C-16. Criteria for transporting pack mules

VEHICLE	CAPACITY (Horses or Mules)
Trailer, 2-horse van	2
Truck, 1½-ton, cargo	2
Truck, 2½-ton, cargo	4
Semitrailer, 6-ton, combination animal and cargo	8
Railroad stock car, 40-foot	Approx 25
Railroad stock car, 36-foot	Approx 20 to 25
Airplane, cargo transport	4 to 6 <sup>1</sup>

<sup>1</sup> May be transported at altitudes up to 18,000 feet with no ill effects.

## Fuel Consumption Rates

For heating, coal stoves need about 20 pounds of coal per day for summer operations (temperatures 10° F or above) and approximately 50 pounds of coal per day for winter operations (temperatures below 10° F). For cooking, coal stoves require approximately 50 pounds of coal per day.

In continuous operations, a 5-kilowatt generator burns about 20 gallons of gasoline per day. A 30-kilowatt generator burns approximately 30 gallons of diesel fuel oil (VVF 800) per day. A 45-kilowatt generator burns approximately 35 gallons of diesel fuel oil (VVF 800) per day.

A Yukon stove burns 5 gallons of gasoline in a 10- to 12-hour period while heating the 10-man arctic tent in temperatures of 0° F and lower. This stove also burns wood or coal.

To start motors and pumps, 0.2 gallon of gasoline is required. This figure is based on an average of 1 hour of operation per day.

#### Oil/Lubrication Consumption Rates

Large, general-purpose tractors use about 2 gallons of engine oil per day. The rate is considered equal for OE 30-10-5. The consumption rate for a light vehicle is 0.006 gallon per mile.

The rate of gear oil consumption is 0.45 gallon per mile for a large, general-purpose tractor; 0.006 gallon per mile for a light vehicle.

GAA is used as an all-purpose grease (also used for water pumps and so forth). The consumption rate is 0.005 pound per mile. Consumption rates for generators and for starting motors and pumps are based on the data shown above for those items.

Initial antifreeze will be added to all vehicles embarking on a cold-weather operation. Refer to Table C-17 to prepare antifreeze solutions.

Table C-17. Guide for preparation of antifreeze solutions

LOWEST EXPECTED AMBIENT TEMPERATURE (°F)	ARCTIC GRADE ANTIFREEZE (-90° F) (MIL-C-11755)	ETHYLENE-GLYCO L ANTIFREEZE (-60° F) (SPEC O-E-771A, TYPE 1)		DENATURED ALCOHOL (GRADE III) <sup>2</sup> PINTS PER GALLON OF COOLANT CAPACITY <sup>1</sup>
		Pints Per Gallon of Coolant Capacity <sup>1</sup>	Specific Gravity (68° F)	
+20	Freezing point of -90° F	1 1/2	1.002	1 1/2
+10		2	1.036	2 1/4
0	Issued ready for use and must not be mixed with any other liquid.	2 3/4	1.047	2 3/4
-10		3 1/4	1.055	3 1/4
-20		3 1/2	1.062	3 1/2
-30		4	1.067	4 1/2
-40		4 1/4	1.073	5
-50		4 1/2		
-60		4 3/4		

<sup>1</sup> Includes heaters and so forth.

<sup>2</sup> Used as temporary emergency expedient when neither arctic grade antifreeze nor ethylene-glycol antifreeze is available.

#### CAUTION

Do not use ethylene glycol full strength. It will freeze at a higher temperature than ethylene-glycol mixed with water.

### Batteries

The electrolyte in acid-type storage batteries is usually composed of sulfuric acid and pure water. The proportion of these two substances determines the specific gravity of the electrolyte. In turn, the specific gravity determines the state of charge of the battery. When the battery discharges, water is formed, causing a reduction in specific gravity. When the battery charges, sulfuric acid is formed, causing an increase in specific gravity. When the ratio of water to acid is 1.275 to 1.300 at 80° F, the battery is fully charged. The proportions of acid to water shown in Table C-18 are used to make electrolytes of various specific gravities at 80° F. Freezing points of the resulting electrolytes are also shown.

Arctic and subarctic temperatures adversely affect the performance of storage batteries. At -30° F, the available energy from a battery is only about 10 percent of what it would be at 80° F. For efficient operation, battery temperatures should be kept from dropping below +30° F. This can be accomplished by using winterization kits. Also, the specific gravity must be kept in the 1.275 to 1.300 range, when corrected to a temperature of

+80° F. Specific gravity changes about .002 for each 5-degree temperature change below or above 80 degrees. Specific gravities and approximate states of charge for various temperatures are given in Table C-19, page C-15.

### Power Vehicles and Sleds

Specifications for power vehicles and sleds used in cold weather operations are shown in Figure C-1, page C-15.

### Ice

Factors that affect the strength of ice include its structure, purity of the water from which it is formed, its cycle of formation (freezing, thawing, and refreezing), temperature, snow cover, and underlying water currents. Also significant is whether or not the ice is water-supported.

Although the sustaining capacity of ice cannot be determined accurately, experience and tests provide the working capacity figures for good quality freshwater ice (Table C-20, page C-16).

Table C-18. Proportions of acid to water/used to make electrolytes

PARTS CONCENTRATED SULFURIC ACID TO ONE PART OF WATER		SPECIFIC GRAVITY	APPROXIMATE FREEZING POINT (°F)
By Volume	By Weight		
0.232	0.416	1.200	-16
0.250	0.545	1.210	-25
0.294	0.527	1.240	-51
0.364	0.667	1.280	-90

Table C-19. Specific gravities and approximate states of charge

TEMPERATURE (°F)	SPECIFIC GRAVITY	APPROXIMATE STATE OF CHARGE (Percent )	TEMPERATURE (°F)	SPECIFIC GRAVITY	APPROXIMATE STATE OF CHARGE (Percent )
-80	1.000 (water)	Fully discharged	-20	1.235-1.260	65
-80	1.130	Discharged	-15	1.237-1.262	68
-75	1.213-1.238	46	-10	1.239-1.264	70
-70	1.215-1.240	48	-5	1.241-1.266	73
-65	1.217-1.242	50	0	1.243-1.268	75
-60	1.219-1.244	52	+5	1.245-1.268	77
-55	1.221-1.246	54	+10	1.247-1.270	79
-50	1.223-1.248	56	+15	1.249-1.272	80
-45	1.225-1.250	58	+20	1.251-1.274	82
-40	1.227-1.252	60	+25	1.253-1.278	84
-35	1.229-1.254	62	+30	1.255-1.280	85
-30	1.231-1.256	63	+80	1.275-1.300	100
-25	1.233-1.258	64			

POWER VEHICLE TYPE – M973, 1 1/2-ton		
GROSS WEIGHT	SPEED	CRUISING RANGE ON ROADS – 200 mi
Front car – 7,200 lb	Road – 31 mph	ARTICULATED TURNING RADIUS – 23 ft
Rear car – 6,800 lb	Water – 2.2 mph	
Total – 14,000 lb		
MAXIMUM PAYLOAD	FORWARD GRADEABILITY	
Front car – 1,100 lb	Hard surface – 60°	
Rear car – 3,100 lb	Snow (32 in) – 30°	
Total – 4,200 lb		
CARGO SPACE		
Front car – 88 cu ft		
Rear car – 194 cu ft		
Total – 282 cu ft		
ENGINE		
Four stroke in line, 5 cylinder, diesel		
NOTE: M973A1 is a four stroke, 6 cylinder diesel		

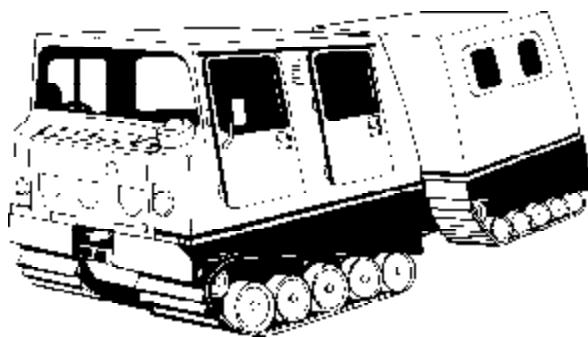


Figure C-1. Power vehicle and sled specifications

Table C-20. Load-bearing capacity of waterborne freshwater ice <sup>1</sup>

LOAD	ICE THICKNESS (in.)	DISTANCE BETWEEN UNITS (ft)
File of soldiers (2-pace interval)	3	
Vehicle class		
1	4	60
2	6	70
4	8	80
6	10	90
8	11.5	100
10	13	110
15	15.5	125
20	18	135
25	20	150
30	22	165
40	25	180
50	28	195
60	31	205

<sup>1</sup> Double figures for old sea ice and triple for young sea ice.

### Temperature, Snow Cover, and Precipitation

The temperature charts in Table C-21, page C-17, and Table C-22, page C-18, may be used as a guide for preliminary planning of operations in the areas shown. The precipitation charts in Table C-23, page C-19, may also be used for preliminary planning of operations. Keep in mind that seasonal storms, may cause some of the figures to vary for short periods. Planners should obtain further information about specific areas. Also, they should include appropriate safety factors into planning for individual clothing, winterizing equipment, and so forth.

Temperatures in the chart are not averages, but are the high and low extremes for each month for each area shown. The figures showing snow cover indicate expected snow depths since packing and partial melting reduce residual quantities.

Mean annual precipitation includes snowfall and rain, with the total represented as inches of water (10 inches of snowfall equals 1 inch of water). Generally, most precipitation above 70° latitude is snow. However, this rule should be used with discretion. Other factors (longitude, sea currents, air currents, and so forth) also affect the type and quantity of precipitation.

### Windchill

The wind-chill factor is the temperature of windless air that would have the same effect on the exposed human skin as a given combination of wind speed and air temperature. See Table C-24, page C-20, for wind-chill factors.

Table C-21. Temperature values for arctic and subarctic areas (January through June)

LOCATION	NORTH LATITUDE Deg Min	TEMPERATURE EXTREMES, °F											
		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
		Low	High	Low	High	Low	High	Low	High	Low	High	Low	High
Alaska	Anchorage	61	10	-40	49	-45	49	-25	54	0	64	20	84
	Aniak	61	35	-65	49	-60	49	-45	54	-30	59	-5	74
	Barrow	71	18	-55	29	-55	24	-45	29	-35	34	-15	39
	Barter Island	70	7	-50	34	-60	24	-40	34	-40	34	-15	44
	Big Delta	64	0	-60	49	-60	49	-40	54	-20	69	15	89
	Cordova	60	30	-25	49	-35	49	-15	59	5	64	20	79
	Fairbanks	64	49	-60	39	-60	44	-40	54	-20	69	15	89
	Galena	64	43	-60	39	-60	39	-45	54	-30	64	-5	84
	Kotzebue	66	52	-45	34	-50	39	-40	34	-25	44	-20	74
	Nome	64	30	-45	39	-50	54	-40	44	-25	54	-15	69
	Umiat	69	22	-60	34	-60	29	-55	39	-50	59	-25	59
	Wales	65	37	-35	34	-40	44	-35	39	-25	44	-5	59
	Wiseman	67	26	-60	39	-60	34	-40	39	-30	49	-5	79
Canada	Aklavik	68	14	-50	29	-60	44	-40	44	-35	59	-15	74
	Alert	82	30	-55	9	-50	14	-50	9	-40	29	-15	44
	Arctic Bay	73	0	-45	24	-55	34	-50	24	-40	29	-10	39
	Baker Lake	64	18	-50	-1	-50	14	-30	19	-35	34	-15	39
	Cambridge Bay	69	7	-55	19	-55	14	-45	19	-40	24	-15	44
	Chesterfield	63	20	-50	34	-55	29	-50	29	-40	39	-20	44
	Clyde	70	27	-40	14	-45	24	-45	24	-30	19	-10	39
	Coppermine	67	49	-55	14	-55	29	-45	29	-35	39	-15	64
	Coral Harbor	64	12	-55	9	-55	29	-35	24	-35	29	-15	39
	Dawson	64	4	-60	39	-60	49	-35	49	-40	64	10	84
	Eureka	80	0	-60	24	-60	1	-60	9	-50	29	-20	44
	Fort Providence	61	20	-60	29	-55	24	-40	54	-25	64	10	74
	Fort Smith	61	1	-50	44	-60	54	-40	49	10	84	-35	79
	Frobisher Bay	63	45	-53	44	-50	39	-45	39	-30	39	-15	54
	Holman Island	70	30	-45	9	-45	19	-35	19	-25	39	-5	39
	Isachsen	78	47	-60	19	-60	-6	-60	9	-40	29	-15	34
	Mould Bay	76	14	-60	9	-55	-1	-55	14	-40	29	-15	34
	Norman Wells	65	17	-50	24	-60	24	-30	49	-15	59	10	74
	Nueltin Lake	60	30	-50	19	-55	19	-40	39	-35	49	-10	69
Greenland	Padloping Island	67	6	-50	29	-50	24	-45	29	-25	44	-15	49
	Resolute	74	43	-55	24	-55	9	-55	19	-35	29	-15	39
	Snag	62	22	-60	34	-60	44	-40	54	-50	59	0	89
	Watson Lake	60	7	-60	44	-60	44	-40	49	-20	59	20	84
	Whitehorse	60	43	-60	44	-60	49	-25	49	-15	59	20	84
	Yellowknife	62	28	-60	39	-60	34	-40	39	-25	64	0	69
	Angmagssalik	65	37	-5	39	-10	39	-5	49	0	54	15	54
	Daneborg	74	18	-25	29	-35	19	-35	24	-20	29	0	49
	Dammarkshavn	76	46	-45	34	-40	34	-30	19	-30	29	-5	39
	Godhavn	69	15	-20	39	-20	44	-15	44	-15	49	10	59
	Godthaab	64	10	-10	44	-5	44	-5	39	5	54	25	64
	Inglefield Bay	77	25	-40	34	-40	29	-40	29	-25	39	10	44
	Julianehaab	60	43	-15	59	-20	49	0	49	5	59	20	64
	Kap Tobin	70	25	-40	29	-45	34	-30	29	-15	34	5	44
	Narssarsuaq	61	11	-30	54	-30	59	-15	59	-5	64	15	69
Iceland	Sondre Stromfjord	67	0	-50	49	-50	54	-45	54	-20	59	-5	69
	Thule	76	31	-40	39	-45	34	-40	24	-30	44	-5	49
	Tingmiarmint	62	32	-5	39	-10	39	0	44	0	44	15	49
	Upemavic	72	47	-25	49	-30	49	-30	44	-20	44	0	54
	Reykjavic	64	8	0	54	5	54	5	49	15	59	15	64
	Seydisfjord	65	16	-5	64	-5	59	5	74	15	64	20	79

Table C-22. Temperature values for arctic and subarctic areas (July through December)

LOCATION	NORTH LATITUDE Deg Min	TEMPERATURE EXTREMES, °F													
		JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER			
		Low	High	Low	High	Low	High	Low	High	Low	High	Low	High		
Alaska	Anchorage	61	10	40	84	30	84	20	74	0	64	-20	54	-35	44
	Aniak	61	35	30	94	20	84	10	69	-20	64	-40	54	-55	44
	Barrow	71	18	25	74	20	74	5	64	-15	44	-40	39	-50	29
	Barter Island	70	7	25	74	25	64	5	64	-20	44	-55	39	-50	34
	Big Delta	64	0	35	94	20	84	5	74	-20	59	-45	54	-60	39
	Cordova	60	30	35	84	30	79	20	69	15	74	-15	54	-20	49
	Fairbanks	64	49	35	94	20	84	10	74	-15	64	-40	49	-60	34
	Galena	64	43	40	89	30	84	15	69	-15	59	-50	44	-60	39
	Kotzebue	66	52	30	84	30	79	15	74	-10	54	-35	39	-45	34
	Nome	64	30	30	74	25	74	15	64	-5	59	-40	44	-45	39
	Umiat	69	22	30	89	20	79	-5	64	-30	49	-55	44	-60	34
	Wales	65	37	35	69	30	74	25	54	10	49	-15	44	-30	34
	Wiseman	67	26	35	89	25	79	5	59	-25	44	-45	34	-55	29
Canada	Aklavik	68	14	35	84	30	79	15	69	-15	59	-40	39	-55	39
	Alert	82	30	25	69	5	54	-15	44	-30	19	-40	24	-50	9
	Arctic Bay	73	0	30	64	30	59	10	49	-15	34	-40	34	-40	14
	Baker Lake	64	18	30	74	30	69	15	49	-10	39	-30	29	-40	19
	Cambridge Bay	69	7	30	69	25	64	10	54	-20	39	-40	24	-50	19
	Chesterfield	63	20	30	84	30	74	15	59	-10	49	-35	39	-50	24
	Clyde	70	27	25	59	25	59	20	44	-5	34	-20	34	-40	19
	Coppermine	67	49	30	84	30	79	15	69	-25	59	-40	34	-40	24
	Coral Harbor	64	12	30	79	25	69	10	49	-10	34	-35	34	-50	29
	Dawson	64	4	35	94	25	84	15	74	-5	64	-50	49	-60	44
	Eureka	80	0	30	69	15	59	-15	39	-45	29	-50	29	-60	14
	Fort Providence	61	20	35	89	25	94	5	79	10	14	-40	49	-60	49
	Fort Smith	61	1	35	99	25	94	15	84	-5	74	-35	44	-55	44
	Frobisher Bay	63	45	30	79	20	74	15	59	-5	44	-35	29	-35	34
	Holman Island	70	30	30	74	25	64	10	44	0	34	-25	19	-30	9
	Isachsen	78	47	25	64	10	59	-10	34	-30	29	-45	19	-55	14
	Mould Bay	76	14	25	59	15	59	-15	39	-25	29	-45	24	-60	14
	Norman Wells	65	17	35	89	30	89	5	69	-5	49	-35	24	-55	14
	Nueltin Lake	60	30	40	84	35	79	15	69	-20	54	-30	39	-40	24
	Padloping Island	67	6	25	74	25	64	5	64	5	59	-35	44	-40	34
	Resolute	74	43	30	64	15	59	0	44	-25	34	-40	29	-55	19
Greenland	Snag	62	22	30	84	25	79	-5	74	-20	59	-55	34	-60	34
	Watson Lake	60	7	35	89	20	84	20	79	-20	69	-40	49	-60	39
	Whitehorse	60	43	30	84	20	84	15	79	5	59	-45	49	-55	49
	Yellowknife	62	28	40	89	35	89	20	69	0	64	-30	39	-50	39
	Angmagssalik	65	37	30	74	30	64	25	64	15	49	0	54	-10	44
	Daneborg	74	18	30	54	25	59	10	44	-15	34	-25	24	-20	14
	Dammarkshavn	76	46	25	59	20	54	5	44	-20	29	-30	29	-35	19
	Godhavn	69	15	35	64	20	54	25	54	10	54	5	44	-5	44
	Godthaab	64	10	35	64	30	59	25	59	10	54	5	49	0	39
	Inglefield Bay	77	25	25	59	25	54	0	49	-15	44	-35	39	-40	29
	Julianehaab	60	43	25	74	30	64	30	69	10	54	0	54	-5	54
	Kap Tobin	70	25	25	54	25	54	20	49	0	34	-25	39	-20	29
	Narssarsuaq	61	11	35	79	30	74	20	74	5	59	-10	59	-35	59
Sondre Stromfjord	Sondre Stromfjord	67	0	30	74	25	74	10	69	-10	69	-30	54	-40	48
	Thule	76	31	25	64	25	59	5	49	-20	34	-30	39	-35	34
	Tingmiarmint	62	32	30	69	30	59	15	59	15	49	10	39	0	39
	Upemavic	72	47	30	64	30	59	20	64	10	44	0	49	-15	44
	Reykjavic	64	8	40	69	30	64	30	64	15	59	10	54	10	54
Iceland	Seydisfjord	65	16	20	74	25	74	30	79	-5	64	0	59	0	59

Table C-23. Precipitation values for arctic and subarctic areas

LOCATION	NORTH LATITUDE Deg Min	PRECIPITATION YEARLY						MEAN PRECIPITATION (IN)		
		Maximum Depth	SNOW DEPTH (IN)			Period	Snow	Rain	Total	
			Month	Average Depth	Period					
Alaska	Anchorage	61 10	27.8	Jan	6.39	Oct - Mar	—	—	14.3	
	Aniak	61 35	32.3	Jan	6.85	Oct - Apr	—	—	19.0	
	Barrow	71 18	22.5	Mar	10.70	Sep - May	—	—	5.3	
	Barter Island	70 7	—	—	—	—	—	—	5.0	
	Big Delta	64 0	54.3	Jan	11.20	Sep - May	—	—	15.0	
	Cordova	60 30	29.0	Jan	8.05	Oct - Apr	132.0	131.8	145.0	
	Fairbanks	64 49	54.3	Jan	9.67	Sep - May	—	—	11.9	
	Galena	64 43	—	—	12.87	Oct - Apr	—	—	17.0	
	Kotzebue	66 52	48.3	Mar	13.19	Sep - May	—	—	9.0	
	Nome	64 30	74.0	Mar	15.70	Oct - May	—	—	17.4	
	Umiat	69 22	22.5	Mar	10.70	Sep - May	—	—	5.0	
	Wales	65 37	74.0	Mar	15.69	Oct - May	—	—	10.5	
	Wiseman	67 26	—	—	—	—	—	—	7.5	
Canada	Aklavik	68 14	48.0	Mar	14.10	Oct - Apr	40.0	5.0	9.0	
	Alert	82 30	—	—	—	—	10.0	Neg	1.0	
	Arctic Bay	73 0	13.0	Mar	8.55	Sep - Apr	40.0	3.0	7.0	
	Baker Lake	64 18	17.5	Apr	10.34	Nov - Apr	50.0	6.0	11.0	
	Cambridge Bay	69 7	17.0	Apr	9.31	Sep - May	36.0	4.0	7.6	
	Chesterfield	63 20	32.0	Dec	13.54	Oct - May	53.0	6.0	11.3	
	Clyde	70 27	25.0	Apr	14.82	Feb - Apr	65.0	4.0	10.5	
	Coppermine	67 49	69.0	Apr	18.82	Oct - May	40.0	5.0	9.0	
	Coral Harbor	64 12	40.0	Feb	17.81	Oct - May	59.0	5.0	10.9	
	Dawson	64 4	45.0	Feb	15.13	Oct - Apr	45.0	7.5	12.0	
	Eureka	80 0	—	—	15.37	Oct - May	10.0	Neg	1.0	
	Fort Providence	61 20	33.0	Dec	12.83	Oct - Apr	45.0	8.0	12.5	
	Fort Smith	61 1	33.0	Mar	10.90	Oct - Apr	42.0	8.5	12.7	
	Frobisher Bay	63 45	74.0	Mar	21.10	Oct - Apr	80.0	7.5	15.5	
Greenland	Holman Island	70 30	16.0	Mar	5.73	Oct - May	34.0	3.5	6.9	
	Isachsen	78 47	—	—	—	—	10.0	Neg	1.0	
	Mould Bay	76 14	—	—	—	—	15.0	1.0	2.5	
	Norman Wells	65 17	51.4	Jan	17.34	Oct - Apr	40.0	7.0	11.0	
	Nueltin Lake	60 30	—	—	—	—	55.0	9.0	14.5	
	Padloping Island	67 6	65.0	Jan	49.00	Jan - Apr	—	—	15.0	
	Resolute	74 43	25.6	May	12.44	Oct - May	30.0	1.0	4.0	
	Snag	62 22	—	—	—	—	60.0	8.0	14.0	
	Watson Lake	60 7	37.8	Feb	15.55	Oct - Apr	60.0	9.5	15.5	
	Whitehorse	60 43	21.8	Feb	6.73	Oct - Apr	50.0	9.5	14.5	
	Yellowknife	62 28	32.0	Jan	12.79	Oct - Apr	40.0	7.5	11.5	
	Angmagssalik	65 37	—	—	—	—	—	—	15.0	
	Daneborg	74 18	—	—	—	—	—	—	8.0	
	Dammarkshavn	76 46	—	—	—	—	—	—	5.0	
	Godhavn	69 15	74.4	Apr	13.87	Oct - May	—	—	7.5	
Iceland	Godthaab	64 10	58.9	Apr	10.63	Sep - May	—	—	18.0	
	Inglefield Bay	77 25	—	—	—	—	—	—	5.0	
	Julianeaaab	60 43	43.3	Mar	7.38	Sep - Apr	—	—	40.0	
	Kap Tobin	70 25	—	—	—	—	—	—	8.0	
	Narssarssuaq	61 11	10.6	Jan	6.15	Jan - Apr	—	—	40.0	
	Sondre Stromfjord	67 0	74.4	Apr	13.87	Oct - May	—	—	14.0	
	Thule	76 31	4.7	Mar	1.87	Oct - Apr	—	—	4.0	
Iceland	Tingmiarmint	62 32	—	—	—	—	—	—	20.0	
	Upemavic	72 47	20.9	Dec	7.46	Sep - May	—	—	10.0	
	Reykjavic	64 8	64.0	Mar	14.00	Oct - May	—	—	34.0	
	Seydisfjord	65 16	—	—	—	—	—	—	20.0	

Table C-24. Windchill factors

		AIR TEMPERATURE (°F)																					
		WIND SPEED (Knots) (mph)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60
Calm	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60	
3-6	5	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-55	-60	-70	
7-10	10	30	20	15	10	5	0	-10	-15	-20	-25	-30	-40	-45	-50	-60	-65	-70	-75	-80	-90	-95	
11-15	15	25	15	10	0	-5	-10	-15	-20	-25	-30	-40	-45	-50	-60	-65	-70	-80	-85	-90	-100	-105	
16-19	20	20	10	5	0	-10	-15	-20	-25	-30	-35	-40	-45	-50	-60	-65	-70	-80	-85	-95	-100	-110	
20-23	25	15	10	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50	-60	-65	-70	-80	-90	-95	-105	-120	
24-28	30	10	5	0	-10	-20	-25	-30	-35	-40	-45	-50	-55	-60	-65	-70	-80	-85	-95	-100	-110	-125	
29-32	35	10	5	-5	-10	-20	-30	-35	-40	-50	-60	-65	-70	-75	-80	-90	-100	-105	-115	-120	-130	-140	
33-36	40	10	0	-5	-15	-20	-30	-35	-45	-55	-60	-70	-75	-85	-95	-100	-110	-115	-125	-130	-140	-150	
		(Winds above 40 mph have little additional effect)																		INCREASING DANGER (Flesh may freeze within 1 minute)			
		LITTLE DANGER																		GREAT DANGER (Flesh may freeze within 30 seconds)			

## ZULUTIME

Figure C-2, page C-22, shows the letter designations for each time zone. These designations are used by the US Armed Forces in communications and operational planning for the identification of zone time (ZT) in the varying time zones. Greenwich mean time or universal time, which is the ZT at Greenwich, is designated "Z" or "Zulu time." Zones to the east of Greenwich are designated alphabetically according to longitude, starting with A and ending with M; the letter J is not used. Zones to the west of Greenwich are similarly designated, starting with N and ending with M or Y ( $\pm 12$ ).

"Zulu" or "Z" time is used in communications when ships or activities in different time zones are involved. By looking at Figure C-2, the time anywhere in the world can be determined.

As an example, note that the eastern part of the United States lies in time zone R (Romeo), 5 hours later than Zulu time. Egypt lies in time zone B (Bravo), 2 hours earlier than Zulu time. The worldwide time conversion chart, Figure C-3, page C-24, shows that at 1800 hours on any given day in New York, it is 0100 hours on the next day in Egypt.

It is sometimes necessary to indicate the date as well as the time in official communications. This is done by prefixing the time group and letter designator with two digits which indicate the date of the current month. Thus, "170925Z" would indicate a date/time of GMT 0925 on the 17th of the current month. This is "Zulu time." If a month other

than the current one is to be used, the date/time group with the appropriate designator is used and the name of the desired month is added as a suffix. If a year other than the current year is used, it is indicated after the month. If the date/time of the message was for 1640 on 23 May 1993, the full group would read 231640 May 93.

## MEASUREMENTS, CONVERSIONS, AND EQUIVALENTS

Units of measure, their conversions, and their equivalents are shown in the following tables and figures.

- Table C-25, page C-26, shows weights and measures.
- Table C-26, page C-27, and Table C-27, page C-28, shows the equivalent units of weight and length.
- Figure C-4, page C-29, shows the conversion scale for km, NM, and st mi.
- Table C-28, page C-29, shows the equivalent units of volume.
- Table C-29, page C-30, shows the conversion factors for metric and US units.
- Table C-30, page C-31, shows the petroleum product weights, measures, and conversions; Table C-31, page C-33, shows the conversion factors for petroleum products; and Figure C-5, page C-34, shows the conversion scale for petroleum products.
- Table C-32, page C-35 shows the equivalent units of speed.
- Table C-33, page C-36, shows temperature conversion from centigrade to fahrenheit and Figure C-6, page C-36 shows the temperature conversion scale.

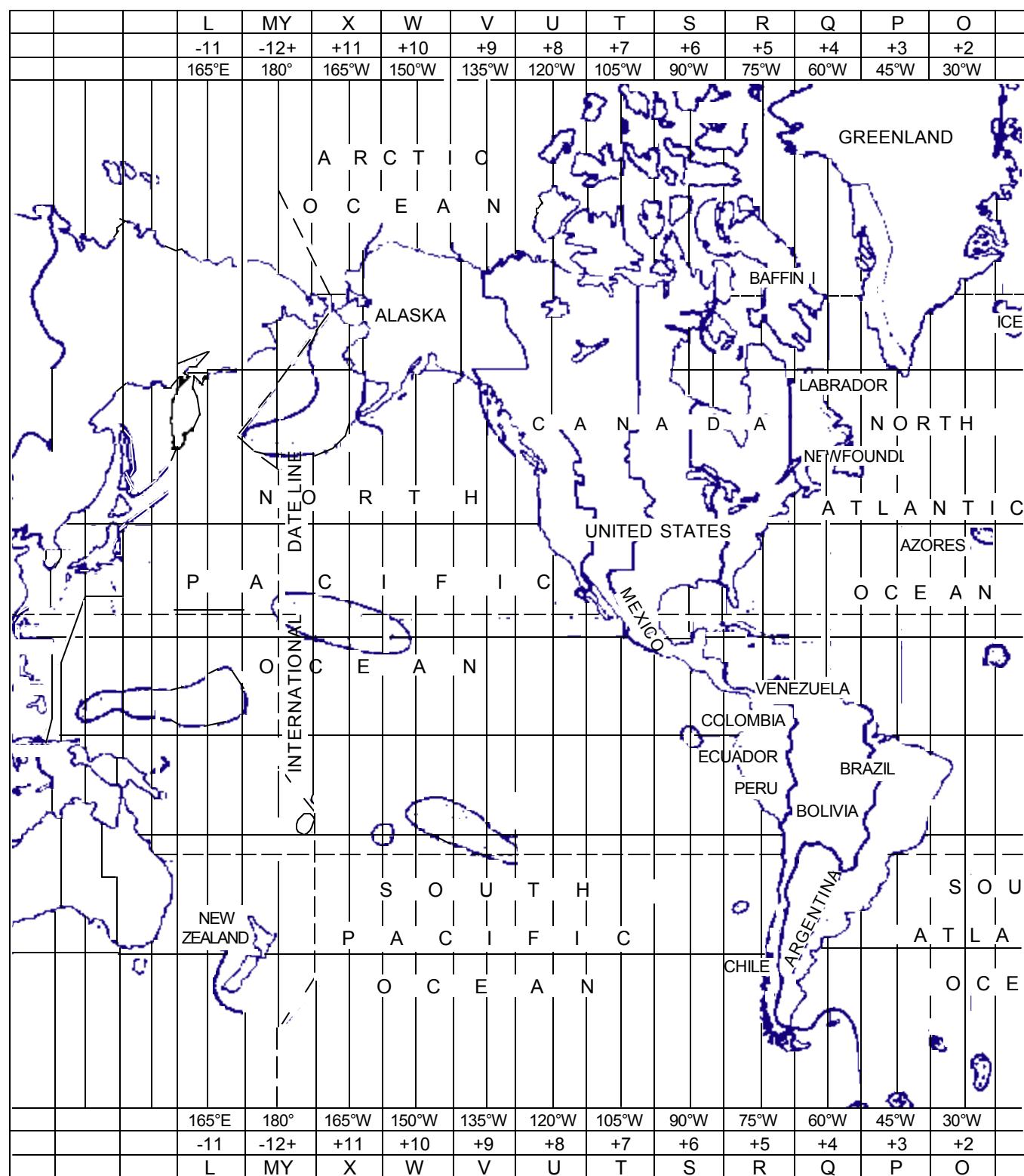


Figure C-2. Time zone chart

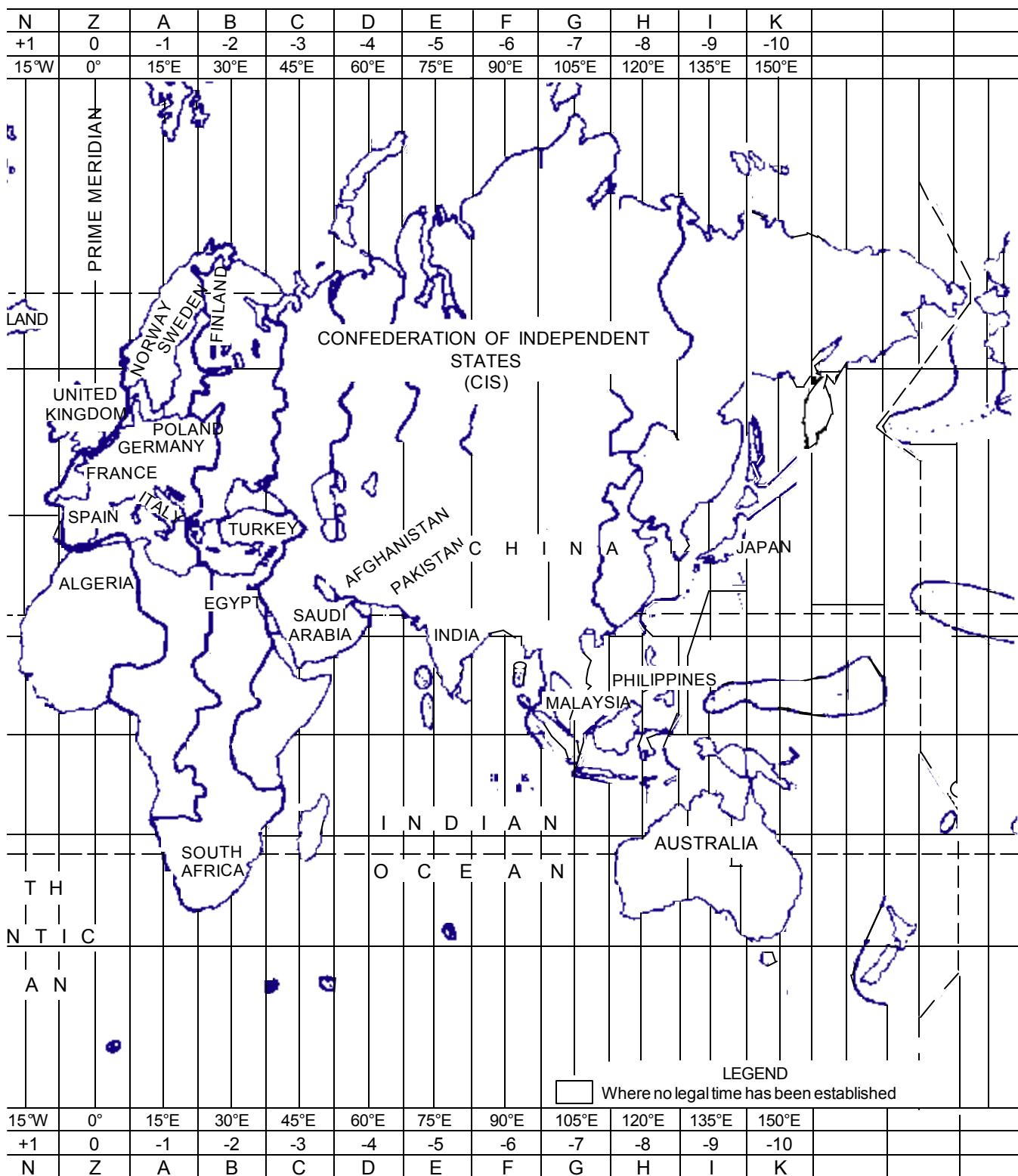


Figure C-2. Time zone chart (continued)

TIME ZONE	HOURS OF DAY IN																								
	PREVIOUS DAY												NEXT DAY												
	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	
Z 0	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	
A -1	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	
B -2	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	
C -3	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	
D -4	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	
E -5	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	
F -6	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	
G -7	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	
H -8	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	
I -9	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	
K -10	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	
L -11	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	
M -12	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	
N +1	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11
O +2	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10
P +3	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09
Q +4	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08
R +5	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07
S +6	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06
T +7	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05
U +8	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04
V +9	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03
W +10	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02
X +11	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01
Y +12	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00

Figure C-3. Worldwide time conversion chart

## LOCAL MEAN TIME

SAME DAY												NEXT DAY													
10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11
11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12
12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13
13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14
14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15
15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16
16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18
18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19
19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
20	21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21
21	22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22
22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09	10
08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08	09
07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07	08
06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06	07
05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05	06
04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04	05
03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03	04
02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02	03
01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01	02
00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00	01
23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	00
22	23	00	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
		SAME DAY																							

Figure C-3. Worldwide time conversion chart (continued)

Table C-25. Weights and measures

DRY MEASURE	FLUID MEASURE
1 pint = 33.6 cubic inches 2 pints = 1 quart 1 quart = 67.2 cubic inches 8 quarts = 1 peck 1 peck = 537.6 cubic inches 4 pecks = 1 bushel 1 bushel = 2,150.42 cubic inches	16 fluid ounces (USA) = 1 pint 20 fluid ounces (Britain) = 1 pint 1 pint = 4 gills 2 pints = 1 quart 4 quarts = 1 gallon 1 gallon = 8 1/2 pounds (approximate) 42 gallons, petroleum = 1 barrel
LINEAR MEASURE	NAUTICAL MEASURE
12 inches = 1 foot 3 feet = 1 yard 16 1/2 feet = 1 rod 5 1/2 yards = 1 rod 320 rods = 1 mile 1,760 yards = 1 mile 5,280 feet = 1 statute mile	6 feet = 1 fathom 100 fathoms = 1 cable length (ordinary) 120 fathoms = 1 cable length (US Navy) 6,080.2 feet = 1 nautical mile
CUBIC MEASURE	SQUARE MEASURE
1,728 cubic inches = 1 cubic foot 27 cubic feet = 1 cubic yard	144 square inches = 1 square foot 9 square feet = 1 square yard 4,840 square yards = 1 acre 43,560 square feet = 1 acre 640 acres = 1 square mile 272 1/4 square feet = 1 square rod
MEASUREMENT OF SURFACES AND SOLIDS	
Circumference of a circle = Diameter x 3.1416 or 6.2832 x radius Area of a square or rectangle = Length x width Area of a circle = Square of the diameter x .7854 or Square of the radius x 3.1416 Surface of a cube = Area of one side x 6 Surface of a sphere = Square of the diameter x 3.1416 Surface of a cylinder = Area of two ends + (height x circumference of one circular base) Cubic content of a cube = Length x width x depth Cubic content of a sphere = Cube of the diameter x .5236 Cubic content of a cylinder = Area of the circular base x the height of cylinder	

Table C-26. Equivalent units of weight

METRIC UNITS		US UNITS	
OUNCES TO GRAMS	GRAMS TO OUNCES	POUNDS TO KILOGRAMS	KILOGRAMS TO POUNDS
1 28.3	1 0.04	1 0.45	1 2.20
2 56.7	2 0.07	2 0.91	2 4.41
3 85.0	3 0.11	3 1.36	3 6.61
4 113.4	4 0.14	4 1.81	4 8.82
5 141.7	5 0.18	5 2.27	5 11.02
6 170.1	6 0.21	6 2.72	6 13.23
7 198.4	7 0.25	7 3.18	7 15.43
8 226.8	8 0.28	8 3.63	8 17.64
9 255.1	9 0.32	9 4.08	9 19.84
10 283.5	10 0.35	10 4.54	10 22.05
LONG UNIT	METRIC TONS	SHORT TONS	CUBIC TONS
One long ton		1.0160	1,016.0
One metric ton	0.9842		1,000.0
One short ton	0.8929	0.9072	907.2
One kilogram			2.2
One measurement ton			40.0

Table C-27. Equivalent units of length

INCHES TO CENTIMETERS				CENTIMETERS TO INCHES			
FEET TO METERS	METERS TO FEET	YARDS TO METERS	METERS TO YARDS	FEET TO METERS	METERS TO FEET	YARDS TO MILES	STATUTE MILES TO KILO- METERS
1	2.54	1	0.39				
2	5.08	2	0.79				
3	7.62	3	1.18				
4	10.16	4	1.57				
5	12.70	5	1.97				
6	15.24	6	2.36				
7	17.78	7	2.76				
8	20.32	8	3.15				
9	22.86	9	3.54				
10	25.40	10	3.94				
11	27.94	11	4.33				
12	30.48	12	4.72				
STATUTE MILES TO KILO- METERS				STATUTE MILES TO KILO- METERS			
1	0.30	1	3.28	1	0.91	1	1.09
2	0.61	2	6.56	2	1.83	2	2.19
3	0.91	3	9.84	3	2.74	3	3.28
4	1.22	4	13.12	4	3.66	4	4.37
5	1.52	5	16.40	5	4.57	5	5.47
6	1.83	6	19.68	6	5.49	6	6.56
7	2.13	7	22.97	7	6.40	7	7.66
8	2.44	8	26.25	8	7.32	8	8.75
9	2.74	9	29.53	9	8.23	9	9.84
10	3.05	10	32.81	10	9.14	10	10.94
NAUTICAL MILES TO KILO- METERS				NAUTICAL MILES TO KILO- METERS			
1	1.61	1	0.62	1	0.87	1	1.15
2	3.22	2	1.24	2	1.74	2	2.30
3	4.83	3	1.88	3	2.61	3	3.45
4	6.44	4	2.49	4	3.48	4	4.60
5	8.05	5	3.11	5	4.35	5	5.75
6	9.66	6	3.73	6	5.22	6	6.90
7	11.27	7	4.35	7	6.09	7	8.05
8	12.87	8	4.97	8	6.96	8	9.20
9	14.48	9	5.59	9	7.83	9	10.35
10	16.09	10	6.21	10	8.70	10	11.50

KILOMETERS	10				0	10	20	30	40	50	60	70	80
NAUTICAL MILES	10				0	10		20		30		40	
STATUTE MILES	10				0	10		20		30		40	

KILOMETERS	100				0	1000	2000	3000	4000	5000	6000	7000	8000
NAUTICAL MILES	100				0	1000		2000		3000		4000	
STATUTE MILES	100				0	1000		2000		3000		4000	

$$\begin{array}{ll} 1 \text{ st mi} = 0.87 \text{ NM} & 1 \text{ NM} = 1.85 \text{ km} \\ 1 \text{ st mi} = 1.61 \text{ km} & 1 \text{ NM} = 1.15 \text{ st mi} \end{array}$$

Figure C-4. Conversion scale (km, NM, and st mi)

Table C-28. Equivalent units of volume

OUNCES TO MILLILITERS				MILLILITERS TO OUNCES			
QUARTS TO LITERS	LITERS TO QUARTS	GALLONS TO LITERS	LITERS TO GALLONS	QUARTS TO LITERS	LITERS TO QUARTS	GALLONS TO LITERS	LITERS TO GALLONS
1	29.57	10	0.34				
2	59.15	20	0.68				
3	88.72	30	1.01				
4	118.29	40	1.35				
5	147.87	50	1.69				
6	177.44	60	2.03				
7	207.01	70	2.37				
8	236.59	80	2.71				
9	266.16	90	3.04				
10	295.74	100	3.38				
1	0.95	1	1.06	1	3.79	1	0.26
2	1.89	2	2.11	2	7.57	2	0.53
3	2.84	3	3.17	3	11.36	3	0.79
4	3.79	4	4.23	4	15.14	4	1.06
5	4.73	5	5.28	5	18.93	5	1.32
6	5.68	6	6.34	6	22.71	6	1.59
7	6.62	7	7.40	7	26.50	7	1.85
8	7.57	8	8.45	8	30.28	8	2.11
9	8.52	9	9.51	9	34.07	9	2.38
10	9.46	10	10.57	10	37.85	10	2.64

Table C-29. Conversion factors (metric and US units)

US OR IMPERIAL UNITS	X	CONVERSION FACTOR	=	METRIC UNITS	METRIC UNITS	X	CONVERSION FACTOR	=	US OR IMPERIAL UNITS
Acres		0.4947		Hectares	Centimeters		0.3937		Inches
Cubic feet		0.0283		Cubic meters	Cubic		0.0610		Cubic inches
Cubic inches		16.3872		Cubic centimeters	Cubic meters		35.3144		Cubic feet centimeters
Cubic inches		0.0164		Liters	Cubic meters		1.3079		Cubic yards
Cubic yards		0.7646		Cubic meters	Decameters		3.9317		Inches
Feet		0.3048		Meters	Grams		15.4324		Grains
Feet per second		18.288		Meters per minute	Grams		0.03527		Ounces (avdp)
Gallons (US)		3.7854		Liters	Hectares		2.4710		Acres
Gallons (imp)		4.543		Liters	Kilograms		2.2046		Pounds (avdp)
Grains		0.0648		Grams	Kilograms		35.2739		Ounces (avdp)
Inches		2.54		Centimeters	Kilometers		0.62137		Miles
Inches		0.0254		Meters	Liters		61.025		Cubic inches
Inches		25.4001		Millimeters	Liters		0.2642		Gallons (US)
Miles		1.6093		Kilometers	Liters		0.220		Gallons
Miles per hour		0.0447		Meters per minute	Liters		2.1134		Pints (US)
Ounces (avdp)		28.349		Grams	Liters		1.76		Pints (imp)
Ounces (avdp)		0.92835		Kilograms	Meters		3.2808		Feet
Pints (US)		0.4732		Liters	Meters		39.37		Inches
Pints (imp)		0.568		Liters	Meters		1.0936		Yards
Pounds (avdp)		0.45359		Kilograms	Meters per minute		0.0547		Feet per second
Square feet		0.0929		Square meters	Meters per second		2.237		Miles per hour
Square inches		6.4516		Square centimeters	Metric ton		2,204.6		Pounds
Square miles		2.590		Square kilometers	Millimeters		0.03937		Inches
Square yards		0.8361		Square meters	Square centimeters		0.155		Square inches
Yards		0.914		Meters	Square kilometers		0.3861		Square miles
					Square meters		1.1960		Square yards
					Square meters		10.764		Square feet

Table C-30. Petroleum product weights, measures, and conversions

PRODUCT/ PACKAGING	VOLUME (Cubic Capacity (lb))	CONVER- SION FACTORS	Planning Factor	Gal to gal	Lb to lb	GALLONS PER			BARRELS PER	PACKAGING PER			VEHICLE CAPACITY FOR CARRYING ILLED CONTAINERS			
						STONs	LTONs	MTONs <sup>1</sup>		LTONs <sup>1</sup>	STONs	LTONs	MTONs	ton	ton	ton
<b>AVGAS</b>																
Bulk	—	—	—	5.90	0.169	339.0	379.7	—	9.04	—	—	—	—	—	—	—
55-gal drums	373.0	9.03	11	6.91	0.145	289.4	324.2	187.8	—	5.36	6.00	3.48	8	14	28	—
55-gal drums	389.0	8.80	11	7.20	0.139	277.8	311.1	192.8	—	5.14	5.76	3.57	8	13	26	—
55-gal drums	364.0	9.20	11	6.90	0.145	289.9	324.6	181.2	—	5.49	6.15	3.42	9	14	28	—
5-gal cans	40.5	0.81	1	8.00	0.125	250.0	280.0	200.0	—	49.40	55.30	40.00	74	124	248	—
<b>Jet fuel (JP4)</b>																
Bulk	—	—	—	6.42	0.156	312.0	349.4	—	8.06	—	—	—	—	—	—	—
55-gal drums	399.0	9.03	11	7.39	0.135	270.0	302.4	187.8	—	5.01	5.61	3.48	8	13	25	—
55-gal drums	415.0	8.80	11	7.68	0.130	260.0	291.2	192.7	—	4.82	5.40	3.57	8	12	24	—
55-gal drums	392.0	9.20	11	7.40	0.135	270.0	302.4	181.2	—	5.10	5.71	3.42	8	14	28	—
<b>MOGAS</b>																
Bulk	—	—	—	6.11	0.164	327.3	366.6	—	8.73	—	—	—	—	—	—	—
55-gal drums	384.0	9.03	11	7.11	0.141	281.2	315.1	187.8	—	5.21	5.83	3.48	8	13	26	—
55-gal drums	400.0	8.80	11	7.41	0.135	269.9	302.3	192.8	—	5.00	5.60	3.57	8	13	26	—
55-gal drums	376.0	9.20	11	7.09	0.141	282.1	315.9	181.2	—	5.32	5.96	3.42	8	14	28	—
5-gal cans	41.6	0.81	1	8.32	0.120	240.4	269.2	200.0	—	48.10	53.80	40.00	73	121	242	—
<b>Diesel fuel</b>																
Bulk	—	—	—	6.99	0.143	286.1	320.5	—	7.63	—	—	—	—	—	—	—
55-gal drums	432.0	9.03	11	8.00	0.125	250.0	280.0	187.8	—	4.63	5.19	3.48	7	12	24	—
55-gal drums	448.0	8.80	11	8.30	0.120	241.0	269.9	192.7	—	4.46	5.00	3.57	7	12	24	—
55-gal drums	430.0	9.20	11	8.11	0.123	246.6	276.2	181.2	—	4.65	5.21	3.42	7	12	24	—
5-gal cans	46.0	0.81	1	9.20	0.109	317.4	243.5	200.0	—	43.50	48.70	40.00	66	109	218	—
<b>Kerosene</b>																
Bulk	—	—	—	6.80	0.147	294.1	329.4	—	7.84	—	—	—	—	—	—	—
55-gal drums	421.0	9.03	11	7.80	0.128	256.4	287.1	187.8	—	4.75	5.32	3.48	8	12	24	—
55-gal drums	437.0	8.80	11	8.09	0.124	247.2	276.9	192.8	—	4.58	5.13	3.57	7	12	24	—
55-gal drums	351.0	9.20	11	6.62	0.151	302.1	338.3	181.2	—	5.70	6.38	3.42	9	15	30	—
5-gal cans	45.0	0.81	1	9.00	0.111	222.2	248.9	200.0	—	44.40	49.80	40.00	67	112	224	—
<b>Lub oils</b>																
Bulk	—	—	—	7.60	0.132	263.2	294.7	—	7.02	—	—	—	—	—	—	—
55-gal drums	472.0	9.03	11	8.58	0.117	233.1	261.0	191.3	—	4.24	4.75	3.48	7	11	22	—
55-gal drums	488.0	8.80	11	8.87	0.113	225.5	252.5	196.4	—	4.10	4.59	3.57	7	11	22	—
55-gal drums	462.0	9.20	11	8.56	0.117	233.6	261.7	184.6	—	4.33	4.85	3.42	7	11	22	—

Table C-30. Petroleum product weights, measures, and conversions (continued)

PRODUCT/ PACKAGING	VOLUME (Cubic Capacity)			CONVER- SION FACTORS			GALLONS PER			BARRELS PER			PACKAGING PER			VEHICLE CAPACITY FOR CARRYING FILLED CONTAINERS				
	WEIGHT (lb)	PACKAGING (cu ft)	Actual Factor	Planning Factor	Gal	Lb	to gal	STON\$	LTONS	MTON\$ <sup>1</sup>	LTONS	STON\$ <sup>1</sup>	LTONS	MTON\$	ton	ton	ton	1 1/2- ton trk	2 1/2- ton trk	5- ton trk
Lub oils (continued)																				
5-gal cans	49.0	0.81	1	9.80	0.102	204.1	228.6	181.2	—	40.80	45.70	40.00	62	103	206	—	—	—	—	
1-qt cans	35.0	0.88	1	—	—	—	—	—	—	58.00	64.90	40.00	86	143	286	—	—	—	—	
(12 per case)																				
1-qt cans	60.0	1.60	2	—	—	—	—	—	—	33.40	37.30	20.00	50	84	168	—	—	—	—	
(24 per case)																				
5-qt cans	77.0	1.90	2	—	—	—	—	—	—	26.00	29.10	20.00	39	65	130	—	—	—	—	
(6 per case)																				
Greases	29.0	0.95	1	—	—	—	—	—	—	—	69.00	77.20	40.00	104	173	346	—	—	—	—
25-lb pails	29.0	0.95	2	—	—	—	—	—	—	45.40	50.90	20.00	69	114	227	—	—	—	—	
5-lb cans	44.0	1.10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
(6 per case)																				
Fog oils	SGF <sub>1</sub>	—	—	—	7.11	0.140	281.0	314.0	—	7.49	—	—	—	—	—	—	—	—	—	
Bulk	—	—	—	—	8.11	0.123	246.6	276.2	191.3	—	4.50	5.02	3.48	7	11	22	—	—	—	
55-gal drums	438.0	9.03	11	8.40	0.110	238.0	266.6	196.4	—	4.32	4.84	3.57	7	11	22	—	—	—	—	
55-gal drums	588.0	8.80	11	8.10	0.123	246.9	276.5	184.6	—	4.57	5.12	3.42	7	11	22	—	—	—	—	
55-gal drums	421.0	9.20	11	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
SGF <sub>2</sub>	—	—	—	—	6.99	0.143	286.0	320.0	—	7.63	—	—	—	—	—	—	—	—	—	
Bulk	—	—	—	—	7.99	0.120	250.3	280.3	191.3	—	4.54	5.09	3.48	7	11	22	—	—	—	
55-gal drums	431.0	9.03	11	8.28	0.120	241.5	270.5	196.4	—	4.39	4.90	3.57	7	11	22	—	—	—	—	
55-gal drums	616.0	8.80	11	7.90	0.121	253.1	283.5	184.6	—	4.68	5.25	3.42	7	11	231	—	—	—	—	

<sup>1</sup> For ocean-shipping, storage, and pipeline computations, bulk petroleum products are usually measured in barrels of 42 gallons each or in LTONS.

<sup>2</sup> 18-gauge standard weighs 54 pounds empty; filled to 54 gallons with light products, 55 gallons with heavy products.

<sup>3</sup> 16-gauge standard weighs 70 pounds empty; filled to 54 gallons with light products, 55 gallons with heavy products.

<sup>4</sup> 18-gauge limited standard weighs 53 pounds empty; fill to 53 gallons with light products, 54 gallons with heavy products.

<sup>5</sup> For planning purposes, weight of MOGAS may be taken as 42 pounds and weight of lube oil for engines as 50 pounds per 5-gallon can, including weight of can. Five-gallon cans weigh approximately 11 pounds empty.

NOTE: Factors in this table are based on US gallons. 1 imperial gallon = 1.2010 US gallons; 1 liter = 0.2462 US gallons.

Table C-31. Conversion factors – petroleum products

MULTIPLY	BY	TO OBTAIN
Cubic feet	7.48	Gallons
Cubic feet	0.1782	Barrels
Cubic feet	0.025	Tons, measurement
Cubic feet	0.01	Tons, register
Cubic feet	28.32	Liters
Cubic inches	0.0043	Gallons
Cubic meters	264.2	Gallons
Cubic meters	6.29	Barrels
Gallons	231.0	Cubic inches
Gallons	0.1337	Cubic feet
Gallons	3.7854	Liters
Gallons	0.0238	Barrels
Gallons (gasoline)	6.103	Pounds
Gallons (gasoline)	0.0031	Tons, short
Gallons (gasoline)	0.0033	Tons, measurement
Gallons (gasoline)	0.0027	Tons, long
Gallons (gasoline)	0.0026	Tons, metric
Gallons (oil)	7.434	Pounds
Kiloliters	0.159	Barrels
Liters	0.2642	Gallons
Liters	0.001	Cubic meters
Pounds	0.1639	Gallons (gasoline)
Pounds	0.1345	Gallons (oil)
Tons, long	367.21	Gallons (gasoline)
Tons, measurement	303.03	Gallons (gasoline)
Tons, measurement	1.0	Tons, short (grease)
Tons, measurement	1.1086	Tons, short (gasoline)
Tons, measurement	1.4285	Tons, short (gasoline in drums)
Tons, measurement	1.2048	Tons, short (oil in drums)
Tons, measurement	40.0	Cubic feet (gasoline)
Tons, metric	373.10	Gallons (gasoline)
Tons, short	327.8	Gallons (gasoline)
Tons, short (gasoline)	0.9195	Tons, measurement
Tons, short (gasoline in drums)	0.7	Tons, measurement
Tons, short (grease)	1.0	Tons, measurement
Tons, short (oil in drums)	0.83	Tons, measurement

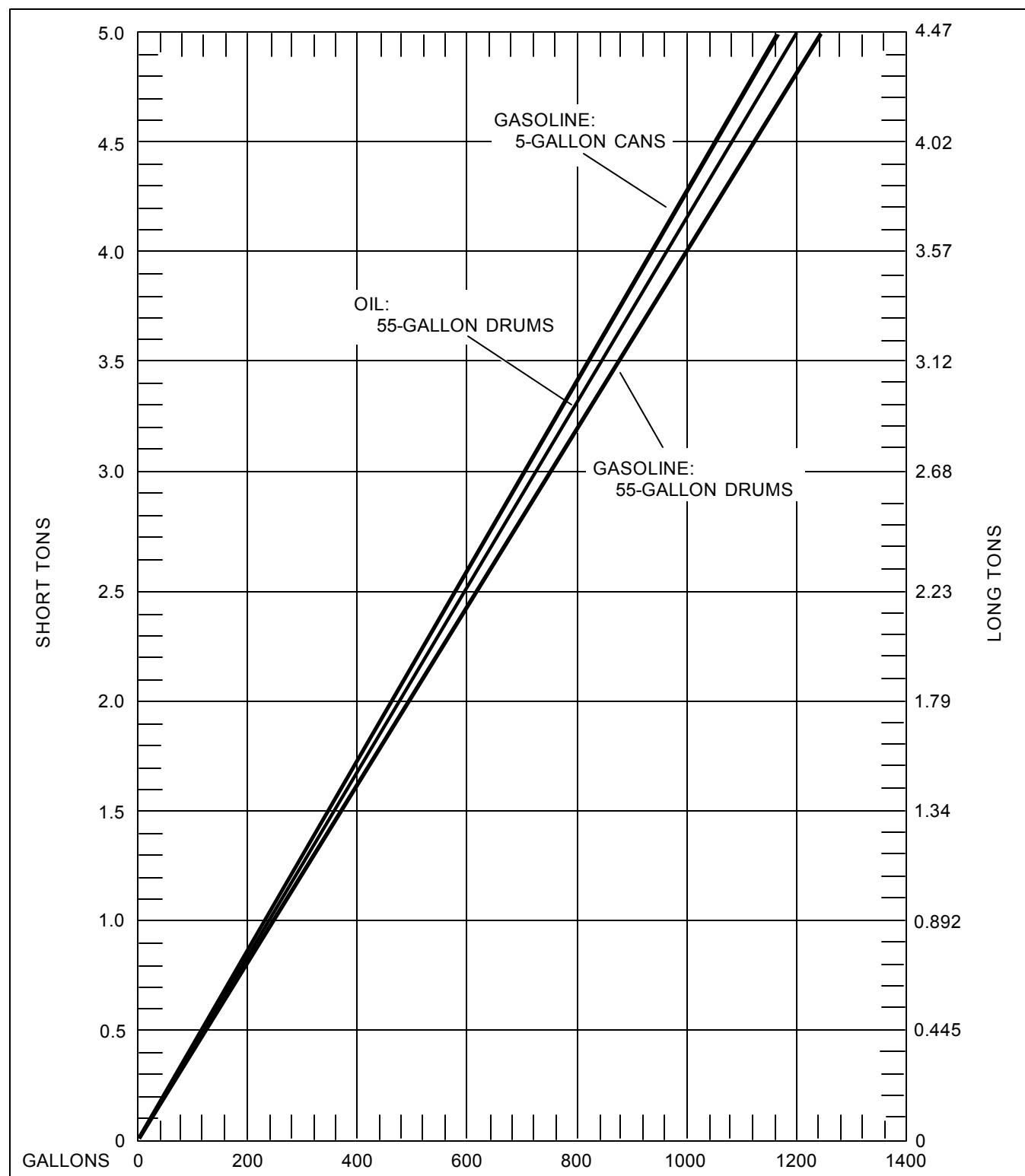


Figure C-5. Conversion scale (gallons, STONs, and LTONs) – petroleum products

Table C-32. Equivalent units of speed

MPH	KNOTS	FT/SEC	KMPH	M/SEC	MPH	KNOTS	FT/SEC	KMPH	M/SEC
1	0.8684	1.4667	1.6093	0.447	26	22.50	38.20	41.90	11.60
2	1.74	2.94	3.23	0.897	27	23.40	39.70	43.50	12.10
3	2.59	4.41	4.83	1.34	28	24.30	41.20	45.10	12.50
4	3.46	5.90	6.45	1.78	29	25.20	42.60	46.70	13.00
5	4.34	7.33	8.05	2.23	30	26.00	44.20	48.30	13.40
6	5.20	8.80	9.65	2.68	31	26.90	45.60	50.00	13.90
7	6.07	10.30	11.30	3.13	32	27.80	47.00	51.50	14.30
8	6.95	11.80	12.90	3.58	33	28.60	48.50	53.00	14.73
9	7.81	13.22	14.50	4.03	34	29.50	50.00	54.55	15.20
10	8.68	14.67	16.09	4.47	35	30.40	51.50	56.50	15.65
11	9.55	16.20	17.70	4.92	36	31.20	53.00	58.00	16.10
12	10.40	17.62	19.30	5.37	37	32.00	54.50	59.70	16.50
13	11.23	19.10	20.90	5.82	38	32.90	56.00	61.40	17.00
14	12.10	20.60	22.60	6.27	39	33.80	57.50	62.80	17.40
15	13.00	22.10	24.20	6.71	40	34.60	58.80	64.50	17.83
16	13.90	23.50	25.80	7.16	41	35.60	60.50	66.00	18.38
17	14.75	25.00	27.40	7.63	42	36.40	61.90	67.70	18.80
18	15.60	26.40	28.90	8.05	43	37.30	63.40	69.20	19.20
19	16.45	28.00	30.60	8.50	44	38.20	64.80	71.00	19.70
20	17.40	29.30	32.20	8.95	45	38.90	66.50	72.50	20.20
21	18.20	30.90	33.80	9.39	46	40.00	67.50	74.00	20.60
22	19.10	32.20	35.40	9.85	47	40.70	69.10	75.90	21.00
23	20.00	33.80	37.10	10.30	48	41.50	70.50	77.50	21.40
24	20.80	35.30	38.60	10.75	49	42.40	72.00	79.00	21.80
25	21.70	36.70	40.30	11.15	50	43.50	73.80	80.50	22.30

Table C-33. Temperature conversions –  
centigrade to Fahrenheit

$^{\circ}\text{C}$	to	$^{\circ}\text{F}$	$^{\circ}\text{F}$	to	$^{\circ}\text{C}$
-20		-4	0		-17.8
-10		14	10		-12.2
0		32	20		-6.7
10		50	30		-1.1
20		68	40		4.4
30		86	50		10.0
40		104	60		15.6
50		122	70		21.1
60		140	80		26.7
70		158	90		32.2
80		176	100		37.8
90		194	120		48.9
100		212	140		60.0
			160		71.1
			180		82.2
			200		93.3

$$^{\circ}\text{C} = \frac{5}{9} (\text{ }^{\circ}\text{F} - 32)$$

$$^{\circ}\text{F} = \frac{9}{5} (\text{ }^{\circ}\text{C} + 32)$$

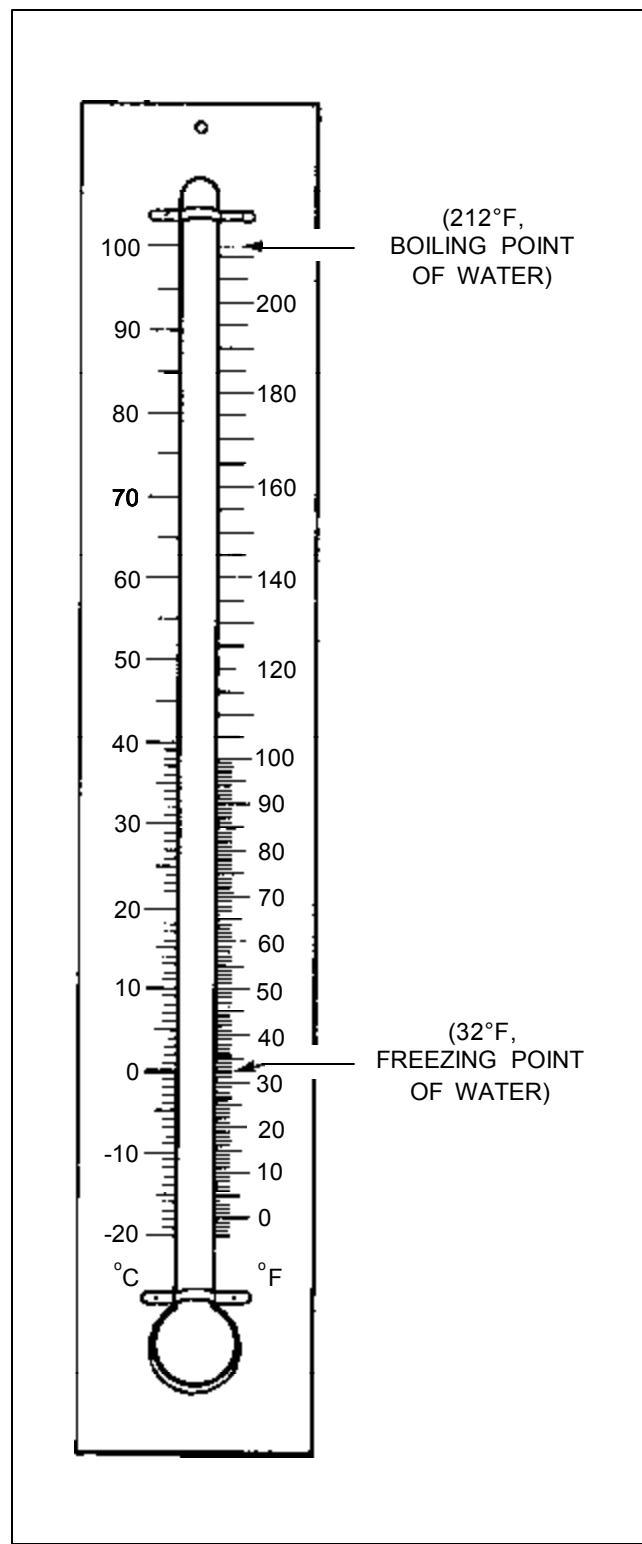


Figure C-6. Temperature conversion scale